

Chapter 6

The Case of Mozambique: The Importance of Management Training for Rice Farming in Rainfed Areas



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Abstract This chapter assesses the results of a randomized controlled trial (RCT) of management training for rice farming in remote rainfed lowland areas of Mozambique. The training taught basic practices but did not require the use of modern purchased inputs such as inorganic fertilizers or modern varieties, which are not easily available to poor farmers in remote areas. The intention-to-treat (ITT) effect on paddy yield was 447–546 kg/ha (29–36% of the control group average yield) with statistical significance at 7–8%. Our analysis also demonstrates that this increase was achieved when key improved management practices were adopted as a package because of the complementarity of the improved practices. These results indicate that the adoption of the practice package alone can improve rice yield substantially even without modern inputs.

6.1 Introduction

Rice yield in Mozambique has remained low at 1 to 1.5 tons/ha of paddy for several decades. Meanwhile, rice consumption has continued to grow rapidly (USDA 2021), with rice imports increasing at a rate of 9.0% annually from 44 thousand tons in 1990 to 650 thousand tons in 2020. This has increased foreign exchange expenditures that could otherwise be used to finance local development projects. Therefore, finding ways to increase the country's rice productivity can provide an important component of its food security strategies (Kajisa 2015; Kajisa and Payongayong 2011; Otsuka and Larson 2013, 2016). The strategy should be designed for a rainfed area, at least in the short or medium term, because the proportion of areas equipped with irrigation facilities remains marginal at about 2% of the country (FAO 2021).

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It has been argued that the dissemination of basic management practices is a key element in increasing rice productivity in rainfed lowland areas in sub-Saharan Africa (SSA), including Mozambique (Kijima et al. 2012; Balasubramanian et al. 2007; Barker and Hardt 1985). The basic management practices include seed selection and nursery bed setup (for quality seedlings), field leveling and bund construction (for even water distribution), straight-row transplanting (for easier crop management and weeding), timely weeding, and water management. The rationale for this strategy is twofold. First, even these basic practices—already common in Asia during its Green Revolution—are not commonly observed or standardized in SSA, as rice was not a dominant staple crop there. Second, this strategy can improve productivity without relying on modern, purchased inputs such as inorganic fertilizers and modern high-yielding varieties. Hence, even cash and market-access-constrained remote farmers could increase rice production if they adopted this strategy. A standard approach to realizing this strategy is the provision of training in basic practices, and thus, we need a better understanding of training effectiveness.

However, empirical evidence on the impact of training in basic rice farm management practices is scarce.¹ The aim of this chapter is to assess the impact of such training provided by the Japan International Cooperation Agency (JICA) in remote rainfed lowland areas in Mozambique using a randomized controlled trial (RCT). The training has three features. First, the training comprised the combination of a conventional approach (farmer field schools (FFS) at demonstration plots) and a contemporary approach (farmer-to-farmer extension (F2FE) through social learning). Second, the training did not provide any performance-based monetary incentives to accelerate technology diffusion. Third, the training did not rely on modern inputs, such as the newly developed improved varieties or inorganic fertilizers. Our study contributes to the literature on agricultural training by assessing the effectiveness of the JICA project with the above characteristics for farmers experiencing cash- and market-access constraints in remote rainfed areas in SSA.

6.2 Rice in Mozambique

Among the major cereals, maize has been the dominant staple in Mozambique, but rice has also been growing in importance. As a result of increased urbanization and the convenience of preparing rice meals, Mozambique, like other African countries, has seen a shift in consumer preference for rice (Hossain 2006). Therefore, rice consumption in Mozambique has rapidly increased by 8.9% annually from 1990 to 2020, faster than the growth in maize consumption at 4.5% or wheat at 6.1% (USDA 2021). In response to this increase, production initially grew at 12.1% annually from 1993 to 1998, but growth has largely stagnated since then (Fig. 6.1). As shown in Fig. 6.2, the modest growth in production can be attributed to the expansion of the

¹ Exceptions include studies on rainfed rice by Nakano et al. (2018) in Tanzania, deGraft-Johnson et al. (2014) in Ghana, and Kijima et al. (2012) in Uganda.

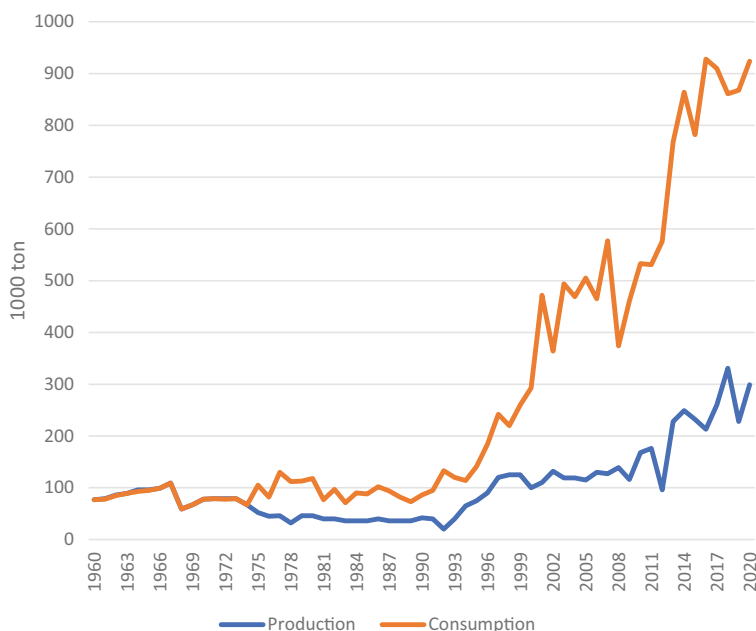


Fig. 6.1 Production and consumption of rice (milled bases) in Mozambique, 1960–2020. *Data Sources* USDA: PS&D Online April 2021; USBC: International Data Base, August 2006

harvested area rather than yield improvements. Paddy yield has stagnated at a level of around 1 to 1.5 tons per hectare, which is below the average yield of 2.2 tons per hectare in SSA (see Fig. 1.5). As mentioned in the introduction, this stagnation has led to a rapid increase in rice imports, as indicated by the widening gap between consumption and production (Fig. 6.1).

Rice in Mozambique is produced mostly in the rainfed lowland ecological regions, where farmers follow traditional cultivation practices. The area equipped with irrigation facilities accounts for only 2% of the arable land in the country. Among the rainfed lowland areas, Zambézia Province, including the Zambézi River basin, is the dominant rice producing province (48% of the total rice area), followed by Nampula (14%), Sofala (12%), and Cebo Delgado (10%) (Ministério da Agricultura e Segurança Alimentar 2015) (Fig. 6.3).

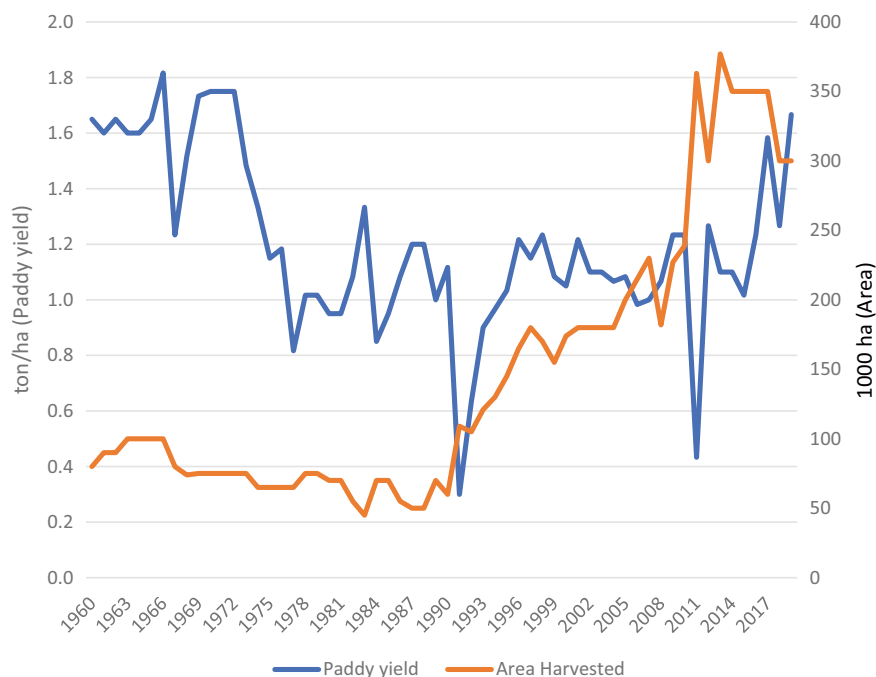


Fig. 6.2 Area harvested and paddy yield in Mozambique, 1960–2020. *Note* Milled rice yields in the original data set were converted to paddy yields at 60% milling recovery rate. *Data Sources* USDA: PS&D Online April 2021; USBC: International Data Base, August 2006

6.3 Experimental Design

6.3.1 JICA Rice Training

The project to provide training on rice farm management practice in Zambézia Province started in 2016 with financial support from JICA. The unit of intervention was the farmer's association. The JICA rice training project, in consultation with the Provincial Directorate of Agriculture and Fisheries (Direcção Provincial de Agricultura e Pescas, DPAP), selected 17 farmer's associations in six local units (*localidade*) in the rainfed area and five associations in five local units in the irrigated area. In this impact assessment study, we focused on the 17 rainfed associations, given the purpose of the study and delays in the rehabilitation projects for irrigation facilities in the selected area.

The project established demonstration plots in each association, using the association's common plots, usually located at an accessible and observable location in the

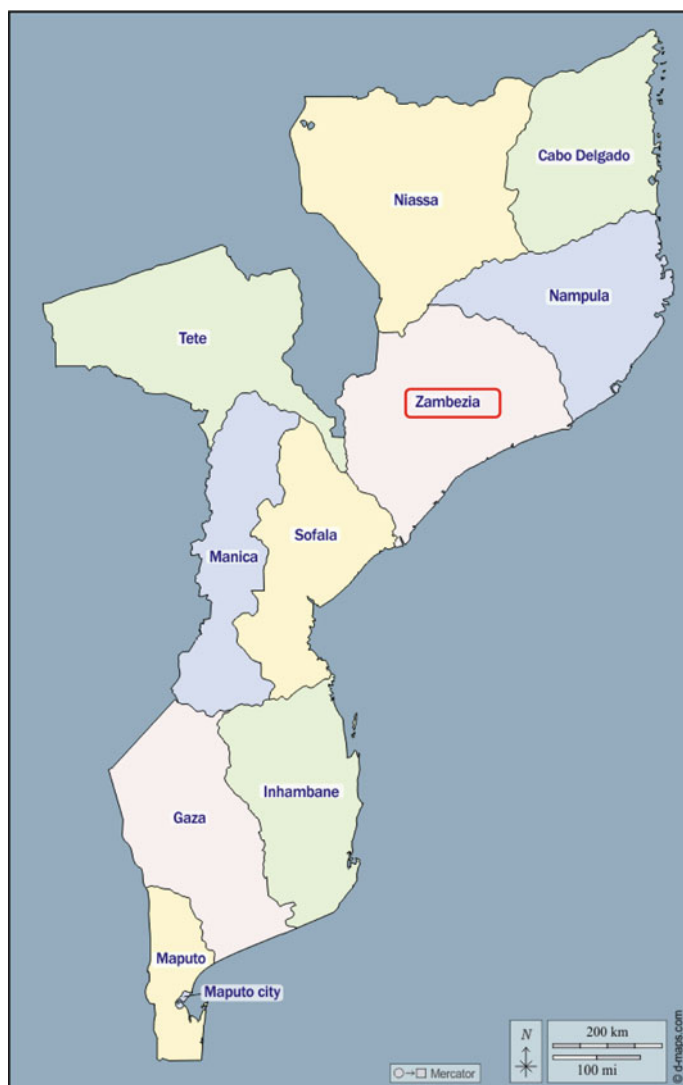


Fig. 6.3 Study site. Source d-map.com, (https://d-maps.com/carte.php?num_car=35360&lang=en), Accessed June 28th, 2022

association's rice area.² In collaboration with the staff of the National Directorate of Assistance to Family Farming (Direcção Nacional de Assistência a Agricultura Familiar, DNAAF), the project provided four training sessions in the demonstration plots. The training sessions provided training in (1) the use of recommended

² If the associations did not have common plots, the project leased private plots suitable for demonstration.

varieties, (2) the seed selection method, (3) the nursery bed setup for seedlings, (4) land leveling, (5) bund construction, (6) straight-row transplanting or straight-row direct sowing, (7) weeding at the proper time, and (8) harvesting at the bottom of the plant, rather than the panicles. The recommended seed selection method was to remove empty seeds floating in the water. All the recommended rice varieties are *local* varieties, rather than modern varieties, which have been developed recently and are usually sold at markets in towns. This is because modern varieties are not easily accessible to the cash and market-access-constrained farmers in remote areas. For the same reason, the use of inorganic fertilizers was not included in the training in the rainfed areas.

To disseminate the improved management practices at the demo plot, the project selected demo farmers who were invited to the demo plot for training and expected to pass on the new practices and technologies to the other member farmers. In this study, we refer to these invitees as “lead farmers” (LF) to ensure that the terms are comparable to the existing literature. Later, due to strong requests from the other member farmers, any other members who wanted to participate in the training were invited to join the project. These participant farmers were called “replica farmers” by the project. However, as they were supposed to be less capable than LF in terms of farming skills and network formulation but eventually participated in the training, we refer to this group as “participant ordinary farmers” (POF). The remaining farmers in the group are called “ordinary farmers” (OF). The ordinary farmers could still observe and learn new practices voluntarily at the demo plot. Moreover, farmers from any group (LF, POF, and OF) could learn the new practices from others at any time. In this regard, the training can be summarized as a hybrid of two approaches: implementing farmer field schools (FFS) in demonstration plots and disseminating learned practices through farmer-to-farmer extension (F2FE).

6.3.2 *Experimental Design and Sample*

There are three to four target associations in each local unit, and we randomized the order of association-level training within each local unit (cluster RCT). This means that one association was randomly selected from each of six local units in the first project year, generating six treated associations. They are labeled Demo 1. The other six associations from each local unit were selected in the second year, and they are labeled Demo 2. This leaves five associations as the control group. Note that Demo 1, Demo 2, and the control group associations are not concentrated in a particular local unit because we randomized the order of training within each local unit. We conducted a pre-training baseline survey in 2017 based on the 2016–17 rice season, and after completing the training in the Demo 1 and Demo 2 groups, a follow-up survey in 2019 on the 2018–19 rice season. Since the associations are far apart and little spillover effect exists between them, we believe that the stable unit treatment value assumption (SUTVA) is not violated. The weather in the baseline rice season

was normal, but the follow-up season had irregular rainfall. Hence, on average, rice yield decreased at the time of the follow-up survey.

Given the number of associations (clusters) in each experimental arm, we conducted a power calculation to obtain an appropriate sample size in each cluster.³ We collected a random sample of 13–25 farmers proportionate to the size of each association, generating 311 observations in the baseline survey. In the follow-up survey, we collected data from 257 farmers in the baseline survey, with the attrition of 54 farmers. Our statistical analysis relies on a balanced panel of these 257 farmers in two periods (514 observations) while statistically controlling for attrition bias.

6.4 Impact of the Training

6.4.1 *Balance Test and Outcome*

Columns (1)–(5) in Table 6.1 show the baseline balance of sample households by treatment. Of the 257 farmers, 78 farmers were under the treatment of the demonstration plot in the first year (Demo 1), and 101 farmers were added in the second year (Demo 2), while the 78 farmers in the control group were not receiving any treatment. The household characteristics consist of household size (heads), household head's schooling years (years), the log of household total asset value (000 MT), total plot area (ha) including non-survey plots, the proportion of known members (%), weather shock in the rice season of the survey year (dummy), and weather shock in the non-rice season immediately before the rice season of the survey year (dummy). The variable “proportion of known members” measures what percentage of sample farmers in the association is known by an interviewed sample farmer, indicating individual network size within the association. The dummy variable “weather shock” takes the value 1 if farmers self-reported that their rice crop suffered from flood, drought, or irregular rainfall.

The table shows that all the household characteristics—either in Demo 1 or Demo 2, except for the proportion of known members—are not statistically different from those of the control group. A joint significance test between Demo 2 and the control

³ A project consultant conducted a pilot study in the study site before our baseline survey, providing useful summary statistics for a power calculation. Using these, we set the mean yield at 1 t/ha, the standard deviation at 1 t/ha, the number of clusters in one experimental arm at 6, intra-cluster correlation (ICC) at 0.15 and, being conventional, the proportion of the yield explained by baseline covariates at 0. We set the significance level at 0.05 and the power of test at 0.8. Under these settings, the sample size of 15 in each cluster generates the statistically detectable change of yield by 0.81 t/ha. Moreover, since we took the baseline data in this project, if the proportion explained by the baseline covariates improves from 0 to 0.4, we can detect the change by 0.74 t/ha. Since the target of the project was to increase yield by 1 t/ha, we decided to set our target sample size in each cluster (association) at 15.

Table 6.1 Baseline balance of sample households by treatment and attrition status

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Demo 1 Mean/SE	Demo 2 Mean/SE	Control Mean/SE	Difference (1)–(3)	Difference (2)–(3)	Non-attrition Mean/SE	Attrition Mean/SE	Difference (6)–(7)
Treated (= 1)								
						0.696 [0.029]	0.796 [0.055]	–0.100
Household size	3.718 [0.226]	4.050 [0.211]	4.282 [0.299]	–0.564	–0.233	3.634 [0.220]	4.352 [0.542]	–0.718
Head's education (years)	3.846 [0.427]	3.574 [0.334]	3.500 [0.398]	0.346	0.074	3.634 [0.220]	4.352 [0.542]	–0.718
Log of asset values	7.563 [0.184]	7.677 [0.139]	7.477 [0.247]	0.085	0.199	7.581 [0.108]	7.208 [0.259]	0.374
Total plot area (ha)	0.813 [0.122]	0.621 [0.078]	0.703 [0.107]	0.110	–0.082	0.704 [0.058]	0.413 [0.044]	0.291**
Proportion of known members (%)	32.869 [2.933]	55.789 [3.713]	41.660 [4.028]	–8.79*	14.13**	44.545 [2.179]	72.627 [4.679]	–28.082***
Weather shock in the last rice season (= 1)	0.115 [0.036]	0.149 [0.036]	0.154 [0.041]	–0.038	–0.005	0.140 [0.022]	0.315 [0.064]	–0.175***
Weather shock in the last non-rice season (= 1)	0.795 [0.046]	0.772 [0.042]	0.833 [0.042]	–0.038	–0.061	0.798 [0.025]	0.907 [0.040]	–0.110*

(continued)

Table 6.1 (continued)

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Demo 1	Demo 2	Control	Difference	Difference	Non-attrition	Attrition	Difference
	Mean/SE	Mean/SE	Mean/SE	(1)–(3)	(2)–(3)	Mean/SE	Mean/SE	(6)–(7)
N	78	101	78			257	54	
F-test of joint significance (F-stat)				1.641	2.577**			4.216***
F-test, number of observations				156	179			311

The values displayed for *t*-tests are the differences in the means across the groups. The values displayed for *F*-tests are the *F*-statistics. ***, **, and * indicate significance at the 1, 5, and 10% critical levels

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(shown at the bottom of the table) was statistically significant, but it became insignificant if we removed the variable of the proportion of known members (the result is not shown in the table).

Columns (6)–(8) in Table 6.1 compare the household characteristics by attrition status, in which we additionally compare the dummy of treatment. The table shows that, although attrition had little to do with treatment, it occurred non-randomly because non-attrition households operated larger areas of farmland, knew fewer farmers in the same association, and were less likely to have experienced weather shocks in both the rice and non-rice seasons. These differences might constitute a source of bias in the impact assessment, which needs to be managed with an appropriate econometric technique.

Table 6.2 shows differences in outcome variables by treatment status at the baseline season (columns (1)–(5)) and the follow-up season (columns (6)–(10)). The outcome variables we examine are the adoption of the practices demonstrated by the training, namely, the adoption of seed selection by water (= 1), setup of the nursery bed (= 1), bund construction (= 1), leveling (= 1), straight-row transplanting (= 1), conducting weeding at least once (= 1), harvesting at the bottom of the plant (= 1), use of sickle for harvesting (= 1), and use of a recommended rice variety of either Chupa (= 1), Mocuba (= 1), or Mamina (= 1). These varieties are local varieties that possess the characteristics of late maturity and high yield, unlike the other popular local variety Nene, which has the features of early maturity and low yield. The adoption of these three varieties is used as our outcome variable because these are the varieties preferred by farmers and recommended by the project. We also compare paddy yield (kg/ha) as the outcome of the project. Note that the weeding variable is empty in the baseline because we failed to collect this information correctly.

The table shows that, at the time of the baseline survey, the adoption of improved practices was quite low (at most about 30%), and the differences by treatment status were statistically insignificant, except for two variables related to harvesting (harvesting at the bottom of the plant and the use of sickle) in the Demo 2 group. Nevertheless, the adoption of these two practices was lower in Demo 2 group than in the control group at the pre-training time. Thus, a possible higher adoption rate at post-treatment does not mean that it was higher from the beginning. Meanwhile, we observe significant differences in rice variety choices.

The paddy yields were low at 1,940 kg/ha in Demo 1, 1,527 kg/ha in Demo 2, and 1,975 kg/ha in the control group, which was understandable under rainfed conditions even for a normal weather season. The low yield of Demo 2 was statistically different from that of the control group at the 10% significance level. We can still use this result to claim that, even if the yield became higher after the training in the Demo 2 group, it was not higher from the beginning.

In the follow-up survey, the adoption rate of recommended practices increased sharply among the treated groups, resulting in statistically significant differences compared to the control group in most cases (about 30–50 percentage points higher

Table 6.2 Changes in outcome variables by treatment status: baseline and follow-up

Variable	Baseline				Follow-up					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Demo 1 Mean/SE	Demo 2 Mean/SE	Control Mean/SE	Difference (1)–(3)	Difference (2)–(3)	Demo 1 Mean/SE	Demo 2 Mean/SE	Control Mean/SE	Difference (6)–(8)	Difference (7)–(8)
<i>Seedling preparation practices</i>										
Seed test, water (= 1)	0.256	0.337	0.231	0.026	0.106	0.769	0.644	0.141	0.628***	0.503***
	[0.050]	[0.047]	[0.048]			[0.048]	[0.048]	[0.040]		
	0.269	0.386	0.333	–0.064	0.053	0.872	0.812	0.333	0.538***	0.479***
	[0.051]	[0.049]	[0.054]			[0.038]	[0.039]	[0.054]		
<i>Land preparation practices</i>										
Plot bunding (= 1)	0.192	0.267	0.218	–0.026	0.049	0.474	0.495	0.192	0.282***	0.303***
	[0.045]	[0.044]	[0.047]			[0.057]	[0.050]	[0.045]		
Plot leveling (= 1)	0.141	0.188	0.244	–0.103	–0.055	0.667	0.455	0.038	0.628***	0.417***
	[0.040]	[0.039]	[0.049]			[0.054]	[0.050]	[0.022]		
<i>Crop care practices</i>										
Straight-row transplanting (= 1)	0.013	0.000	0.000	0.013	N/A	0.462	0.356	0.000	0.462***	0.356***
	[0.013]	[0.000]	[0.000]			[0.057]	[0.048]	[0.000]		
Weeding at least once (= 1)	N/A	N/A	N/A	N/A	N/A	0.628	0.455	0.359	0.269***	0.096
						[0.055]	[0.050]	[0.055]		

(continued)

Table 6.2 (continued)

Variable	Baseline				Follow-up					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Demo 1 Mean/SE	Demo 2 Mean/SE	Control Mean/SE	Difference (1)–(3)	Difference (2)–(3)	Demo 1 Mean/SE	Demo 2 Mean/SE	Control Mean/SE	Difference (6)–(8)	Difference (7)–(8)
<i>Harvesting practices</i>										
Harvesting at the bottom of plant (= 1)	0.038 [0.022]	0.010 [0.010]	0.051 [0.025]	–0.013	–0.041*	0.526 [0.057]	0.465 [0.050]	0.192 [0.045]	0.333***	0.273***
Using sickle to harvest	0.295 [0.052]	0.277 [0.045]	0.410 [0.056]	–0.115	–0.133*	0.615 [0.055]	0.426 [0.049]	0.321 [0.053]	0.295***	0.105
<i>Rice varieties</i>										
Using Chupa variety (= 1)	0.128 [0.038]	0.050 [0.022]	0.026 [0.018]	0.103**	0.024	0.231 [0.048]	0.337 [0.047]	0.064 [0.028]	0.167***	0.273***
Using Mocuba variety (= 1)	0.179 [0.044]	0.168 [0.037]	0.295 [0.052]	–0.115*	–0.127**	0.359 [0.055]	0.168 [0.037]	0.231 [0.048]	0.128*	–0.062
Using Mamima variety (= 1)	0.179 [0.044]	0.139 [0.035]	0.269 [0.051]	–0.090	–0.131**	0.179 [0.044]	0.119 [0.032]	0.167 [0.042]	0.013	–0.048
<i>Output</i>										
Paddy yield (ha)	1939.7 [172.671]	1527.1 [139.327]	1974.9 [197.380]	–35.191	–447.794*	1782.5 [126.150]	1751.5 [109.771]	1535.8 [131.771]	246.659	215.661
N	78	101	78			78	101	78		
F-test of joint significance (F-stat)				2.096**	2.294***				18.186***	11.436***
F-test, number of observations				156	179				156	179

N/A: No data available or no statistical comparison possible. The values displayed for *t*-tests are the differences in the means across the groups; The values displayed for *F*-tests are the *F*-statistics; ***, **, and * indicate significance at the 1, 5, and 10% critical levels

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than the control group's adoption levels). When comparing yield, we must note that the follow-up season suffered from irregular rainfall, and thus the *overall* average at the study site decreased slightly from approximately 1,800 kg/ha at the baseline to about 1,700 kg/ha at follow-up. However, we can still observe differential outcomes by treatment status: the reduction for Demo 1 was marginal and Demo 1 achieved 1,783 kg/ha. Furthermore, Demo 2 improved its yield to 1,752 kg/ha, while the yield of the control group decreased to 1,536 kg/ha. This implies that Demo 1 and 2 associations were able to mitigate the weather shock. As a result, the yields of Demo 1 and Demo 2 were approximately 200 kg/ha higher than those of the control group, although the differences were not statistically significant at any conventional level. We will examine these impacts in a more statistically rigorous manner in the next sub-section.

6.4.2 Econometric Analysis

To assess the causal influence of the provision of training on the outcomes of our interest, we estimate intention-to-treat (ITT) effects by employing an analysis of covariance (ANCOVA) model specified below (McKenzie 2012).

$$Y_{ijk1} = \beta_0 + \gamma Y_{ijk0} + \beta_1 D_{jk}^1 + \beta_2 D_{jk}^2 + X_{ijk0} \delta + \eta_k + \varepsilon_{ijk1} \quad (6.1)$$

where Y_{ijk1} and Y_{ijk0} are the follow-up and baseline outcome variables of the most important rice plot of household i in association j in local unit (*localidade*) k ; D_{jk}^1 and D_{jk}^2 are the treatment dummy variables, equal to 1 if association j in local unit k sets up the demonstration plot in the first round (Demo 1) or the second round (Demo 2), respectively; X_{ijk0} is a set of baseline control variables; η_k is the local unit fixed effect; ε_{ijk1} is the unobserved error term. Our primary outcome variable Y_{ijk1} is the paddy yield (kg/ha). Our Y_{ijk1} also includes individual management practices and variety adoption. For management practices, we focus on five essential ones: seed test by water (S), nursery bed setup (N), bund construction (B), field leveling (L), and straight-row transplanting (TP). We cannot include weeding in the set of crop care practices due to the lack of baseline data.⁴ In addition, we do not include the two recommended harvesting practices because they are not yield improving practices. Meanwhile, we include the dummy of adoption of five practices as a package in order to identify the complementarity effects among them. When the outcome is binary, the employed model is a linear probability model. Our baseline control variables (X_{ijk0}) are the variables used in the balance test in Table 6.1, and the squared terms for household size and total plot area.

⁴ It is possible to show the status of weeding adoption and its impact at follow-up. The trend of this practice is similar to those of the other practices: The yield of weeding adopters is lower than the non-adopters in the follow-up. This is partly due to self-selection: farmers who suffered weed problems did weeding more frequently.

A possible attrition bias was adjusted using the inverse-probability weighting method suggested by Wooldridge (2010). We run a probit regression model that estimates the probability of non-attrition, while using the inverse of the probability as weights in Eq. (6.1).⁵ The probit regression results are presented in Appendix Table 6.7.

Table 6.3 shows the estimation results of the treatment effects (β_1 and β_2) in Eq. (6.1). Hereafter, all the results present wild bootstrap cluster robust p -values because the number of clusters in our data is less than 42, the threshold for the use of cluster robust standard errors suggested by Angrist and Pischke (2009).⁶ The t -test of an equal impact between Demo 1 and Demo 2 (i.e., $\beta_1 = \beta_2$,) is shown in the lower part of the table. The full regression results with the other control variables are listed in Table 6.7 in the Appendix.

The results on the yield in column (1) in Table 6.3 indicate that the project increased the yield of the Demo 1 group by 545.5 kg/ha at a p -value of 7.95% and that of the Demo 2 group by 447.5 kg/ha at a p -value of 6.50%, which corresponds to a 35.5% or 29.1% increase from the control group yield, respectively (see the control group mean of 1,535 kg/ha at the lower part of the table).⁷ The t -test of equal impact does not reject the null hypothesis, indicating that a one-year lag in training implementation did not create a significant disadvantage. However, the magnitude is higher in Demo 1 by 98 kg/ha.

As the high adoption rates of the improved management practices in Demos 1 and 2 in Table 6.2 suggest, the impact of the training on those outcomes is positive and statistically highly significant (columns (2)–(6)), with no statistical difference between β_1 and β_2 . The impact of training for the full adoption of five practices (Column (7)) shows a significant result in the Demo 1 group at a p -value of 6.3%, while Demo 2 gives a positive coefficient at 20% of the p -value, suggesting that a sequential adoption of all five practices requires time. The results for variety adoption (columns (8)–(10)) are ambiguous.

In summary, the training enhanced the adoption of recommended basic practices and increased the yield by 0.4 or 0.5 t/ha among the farmers in the treated associations. A remaining question is: How did the farmers in the treated associations increase yield?

⁵ The explanatory variables consist of the same variables in X s and the squared term of the head's education.

⁶ For wild bootstrap, see Roodman et al. (2019) and Wooldridge (2010).

⁷ As a robustness check, we combine Demo 1 and Demo 2 dummies and estimate the impact of the training as a whole. The estimate is 481.9 kg/ha at a p -value of 3.7%.

Table 6.3 Estimated results of ANCOVA model on the impact of training: rice productivity and technology adoption

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Paddy yield	(S) Seed test by water	(N) Nursery bed set up	(B) Bund	(L) Leveling	(S) Straight-row TP	Use all 5	Use Mamima	Use Mocuba	Use Chupa
Demo 1 (treatment)	545.5* [0.0795]	0.570*** [0.0085]	0.592*** [0.0005]	0.376** [0.0440]	0.609** [0.0390]	0.508* [0.0750]	0.367* [0.0635]	0.0903* [0.0985]	0.0895 [0.3710]	0.0899 [0.6010]
Demo 2 (treatment)	447.5* [0.0650]	0.479* [0.0710]	0.461*** [0.0000]	0.326** [0.0265]	0.416** [0.0400]	0.449** [0.0100]	0.200 [0.2015]	-0.00583 [0.8485]	-0.0568 [0.7730]	0.289 [0.1380]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
t-test (Demo 1 = Demo 2)	0.8372 [0.5005]	0.7911 [0.5795]	1.3768 [0.3330]	0.5446 [0.7695]	1.3559 [0.4005]	0.4146 [0.7605]	1.7405 [0.1900]	2.0472* [0.0570]	1.8529 [0.1910]	-1.7335 [0.2235]
Control mean value	1535	0.141	0.333	0.192	0.038	0.00	NA	0.167	0.231	0.064
Observations	257	257	257	257	257	257	257	257	257	257
R-squared	0.363	0.300	0.413	0.510	0.395	0.380	0.418	0.403	0.525	0.302

Wild bootstrap cluster robust p -values in brackets; Inverse probability weights are used to control for attrition bias (see Appendix Table 6.7 for the probit analysis of non-attrition)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

See Appendix Table 6.8 for full regression results

Source Authors

6.5 Practice Adoption and Diffusion

6.5.1 *Adoption and Yield Increase*

To answer the above question, we examine what practices and rice varieties increased the yield. Panel A in Table 6.4 shows the percentage of adopters of individual practices or their packages and corresponding yields among the entire sample ($n = 257$) at the baseline and follow-up seasons. The asterisks on the yield values indicate the significant mean difference from the yield under no adoption based on the t -test.

Regarding the impact of adoption, one of the key questions is whether yield increases resulted from farmers adopting all five practices as a package or whether single or partial adoption still increases yield. The answer to this question is practically important because it determines the specific recommendations given to farmers in the training. Consequently, while Table 6.4 shows the yield under the solo or partial adoption from the five practices, we do not include the farmers who adopted all five practices in this data. For example, in the case of the adoption of the Seed test by water ((S) in the table), the results do not include the farmers who adopted all five practices—only the farmers who adopted the seed test alone or the seed test plus some other practices but not all the other practices. If the adoption of (S) alone still has an impact, yield under (S) is expected to be higher than in the case of no adoption. The table also shows the case of combining any single or partial adoptions of five practices in one row above the case of full adoption. Hence, the sum of “No adoption,” “Any single or partial adoption,” and “All 5 practices” is 100%. Henceforth, we refer to the farmers who adopted all five practices as full adopters.

Panel A shows these three features. First, unexpectedly, at baseline, the case of no adoption shows the highest yield. This may be because farmers experiencing very favorable agro-ecological conditions were able to achieve high productivity with conventional practices. Second, at the baseline, there was no full adopter at all, while there were some single and a few partial adopters. Third, at the follow-up survey, the proportion of full adopters increased to 12% and they achieved the highest yield (2,206 kg/ha), although the difference was not statistically significant due to the small sample size.

Panel B in Table 6.4 shows the impact of variety adoption. We did not find significant differences in yield except for the use of the Mocuba variety at baseline. Mocuba again shows the highest yield at the follow-up with almost the same proportion of users. This may be because each farmer was already using a variety suitable for their local conditions before the training. Our data strongly suggest, at least in our study site, that rice variety adoption was not a major driving force of yield improvement. From this point, we focus on the exploration of improved practice adoption only.

Table 6.4 Improved management practices, variety adoption and paddy yield in the follow-up survey

Panel A: Key practices				
	-----Baseline-----		-----Follow-up-----	
Adoption status	Percentage of farmers (%)	Paddy yield (kg/ha)	Percentage of farmers (%)	Paddy yield (kg/ha)
No adoption	37	2098	20	1805
<i>Partial Adoption^a</i>				
<i>Seedling preparation practices</i>				
(S) Seed test by water	28	1295***	41	1536
(N) Nursery bed set up	33	1611 *	56	1596
<i>Land preparation practices</i>				
(B) Bund construction	23	1262***	28	1614
(L) Leveling	19	1740	27	1507
<i>Crop care practice</i>				
(TP) Straight-row planting	0.4	2442	16	1326**
<i>Combinations</i>				
(S) + (N)	11	657***	35	1552
(B) + (L)	8	1924	11	1596
(S) + (N) + (B) + (L)	2	1276	5	1384
(S) + (N) + (TP)	0	Na	14	1227
(B) + (L) + (TP)	0	Na	1	2158
Any single or partial adoption	63	1609**	67	1571
<i>Full Adoption</i>				
All 5 practices (S) + (N) + (B) + (L) + (TP)	0	Na	12	2206
Panel B: Key varieties				
	-----Baseline-----		-----Follow-up-----	
Adoption status	Percentage of farmers (%)	Paddy yield (kg/ha)	Percentage of farmers (%)	Paddy yield (kg/ha)
Neither Chupa, Mamima, nor Mocuba	53	1678	38	1698

(continued)

Table 6.4 (continued)

Panel B: Key varieties				
	-----Baseline-----		-----Follow-up-----	
Adoption status	Percentage of farmers (%)	Paddy yield (kg/ha)	Percentage of farmers (%)	Paddy yield (kg/ha)
Variety Chupa	7	1792	22	1493
Variety Mamima	19	1486	15	1572
Variety Mocuba	21	2316**	25	1949

^a Individual or partial adoption does not include the case of all 5 adoptions; *** $p < 0.01$, ** $p < 0.05$, the mean difference from the case of “No adoption”(0); Sample size = 257

** $p < 0.05$, the mean difference from the case of “Neither Chupa, Mamima, nor Mocuba”; Sample size = 257

Source Authors

6.5.2 Characteristics of the Full Adopters

The fact that full adopters achieved the highest yield warrants special attention. Table 6.5 compares the full adopters with the non or incomplete adopters of the five key practices by three types of farmers, namely LF, POF, and OF in the treated associations ($n = 179$). Since the number of non-adopters among each farmer type is very small, the qualitative results are the same even if we separate non- and incomplete adopters. Seven features can be identified from the table. First, the proportions of full adopters shown at the bottom of the table indicate that LF achieved the highest adoption (23%), followed by similar proportions by POF (15%) and OF (16%). Given the intensity of the training, it is naturally expected to observe the highest proportion for LF, followed by that of POF. The 16% total for full adoption among OF indicates the existence of farmer-to-farmer diffusion mechanisms or OFs' voluntary training participation.

Second, the full adopters achieved the highest yield for any type. Interestingly, OF shows the largest improvement, and this increase was the only one to achieve statistical significance among the three types of farmers.

Third, we do not find advantages among the full adopters in terms of their socio-economic and agro-ecological conditions, such as household size, education, asset holdings, plot size, or weather conditions. Some variables show statistically significant differences between the full adopters and the non or incomplete adopters, but the differences are not consistent across the three types of farmers.

Fourth, the size of the baseline social networks was measured by the proportion of known LF, POF, or OF among the sample members at the baseline. The results indicate that the full adopters' networks were generally smaller than those of the non or incomplete adopters. This is contrary to our presumption of a social learning mechanism.

Table 6.5 Characteristics of full adopters by farmer's training status

Variable	-----LF-----			-----POF-----			-----OF-----		
	(1)	(2)	t-test	(1)	(2)	t-test	(1)	(2)	t-test
Non or incomplete adopters	Non or incomplete adopters	Full adopters	Difference	Non or incomplete adopters	Full adopters	Difference	Non or incomplete adopters	Full adopters	Difference
Mean/SE	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)
Paddy yield (kg/ha) (follow-up)	1506.545 [189.594]	1897.733 [345.916]	391.188	1509.208 [216.710]	1877.083 [422.779]	367.875	1742.170 [104.960]	2380.032 [335.675]	637.862**
Household size (baseline)	3.222 [0.304]	4.250 [0.559]	1.028	4.294 [0.695]	4.000 [1.528]	-0.294	3.913 [0.199]	4.300 [0.493]	0.387
Head's education (years) (baseline)	3.296 [0.662]	5.875 [1.445]	2.579*	3.529 [0.836]	5.333 [2.906]	1.804	3.913 [0.337]	2.100 [0.794]	-1.813**
Log of assets (baseline)	8.005 [0.261]	8.349 [0.336]	0.345	8.303 [0.371]	7.704 [0.621]	-0.599	7.541 [0.150]	6.690 [0.291]	-0.851**
Total plot area (ha) (baseline)	0.960 [0.191]	0.949 [0.581]	-0.011	0.952 [0.255]	0.233 [0.017]	-0.719	0.583 [0.065]	0.758 [0.326]	0.175
Weather shock in the last rice season (= 1) (baseline)	0.000 [0.000]	0.250 [0.164]	0.250***	0.059 [0.059]	0.000 [0.000]	-0.059	0.163 [0.036]	0.200 [0.092]	0.037

(continued)

Table 6.5 (continued)

Variable	-----LF-----			-----POF-----			-----OF-----		
	(1)	(2)	t-test Difference	(1)	(2)	t-test Difference	(1)	(2)	t-test Difference
Non or incomplete adopters	Non or incomplete adopters	Full adopters	(2)-(1)	Non or incomplete adopters	Full adopters	(2)-(1)	Non or incomplete adopters	Full adopters	(2)-(1)
Mean/SE	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)
Weather shock in the last non-rice season (= 1) (baseline)	0.704 [0.090]	0.875 [0.125]	0.171	0.765 [0.106]	1.000 [0.000]	0.235	0.788 [0.040]	0.800 [0.092]	0.012
Proportion of baseline known LF (%) (baseline)	8.708 [1.440]	5.286 [2.282]	-3.422	6.596 [1.017]	2.381 [1.190]	-4.215	8.296 [0.706]	1.964 [0.408]	-6.332***
Proportion of baseline known POF (%) (baseline)	2.783 [0.807]	1.839 [1.361]	-0.944	3.679 [1.036]	4.762 [2.381]	1.083	3.205 [0.339]	3.393 [0.915]	0.188
Proportion of baseline known OF (%) (baseline)	19.162 [3.908]	17.214 [10.451]	-1.948	23.334 [6.256]	42.857 [12.542]	19.523	30.962 [2.649]	19.319 [5.274]	-11.644*

(continued)

Table 6.5 (continued)

Variable	-----LF-----				-----POF-----				-----OF-----			
	(1)	(2)	t-test		(1)	(2)	t-test		(1)	(2)	t-test	
	Non or incomplete adopters	Full adopters	Difference	(2)-(1)	Non or incomplete adopters	Full adopters	Difference	(2)-(1)	Non or incomplete adopters	Full adopters	Difference	(2)-(1)
Join all 4 demo farm trainings (follow-up)	Mean/SE 0.333 [0.092]	Mean/SE 0.750 [0.164]	Mean/SE 0.417** [0.081]	0.118	Mean/SE 0.118 [0.081]	Mean/SE 0.000 [0.000]	Mean/SE 0.118 [0.081]	0.000	Mean/SE 0.231 [0.042]	Mean/SE 0.500 [0.115]	Mean/SE 0.269** [0.042]	0.231
Knows at least one full adopter among the baseline members	Mean/SE 0.185 [0.076]	Mean/SE 0.750 [0.164]	Mean/SE 0.565*** [0.081]	0.118	Mean/SE 0.118 [0.081]	Mean/SE 1.000 [0.000]	Mean/SE 0.118 [0.081]	0.882*** [0.000]	Mean/SE 0.327 [0.046]	Mean/SE 0.850 [0.082]	Mean/SE 0.523*** [0.046]	0.327
Existence of known LF from whom respondent learned any 5 practices	Mean/SE 0.630 [0.095]	Mean/SE 0.125 [0.125]	Mean/SE -0.505** [0.125]	0.471	Mean/SE 0.471 [0.125]	Mean/SE 0.667 [0.333]	Mean/SE 0.471 [0.125]	0.196 [0.333]	Mean/SE 0.452 [0.049]	Mean/SE 0.350 [0.109]	Mean/SE -0.102 [0.109]	0.452

(continued)

Table 6.5 (continued)

Variable	-----LF-----			-----POF-----			-----OF-----		
	(1)	(2)	t-test Difference (2)-(1)	(1)	(2)	t-test Difference (2)-(1)	(1)	(2)	t-test Difference (2)-(1)
Existence of known POF from whom respondent learned any 5 practices	Non or incomplete adopters Mean/SE 0.444 [0.097]	Full adopters Mean/SE 0.000 [0.000]	-0.444**	Non or incomplete adopters Mean/SE 0.294 [0.114]	Full adopters Mean/SE 0.000 [0.000]	-0.294	Non or incomplete adopters Mean/SE 0.106 [0.030]	Full adopters Mean/SE 0.000 [0.000]	-0.106
Existence of known OF from whom respondent learned any 5 practices	0.333 [0.092]	0.000 [0.000]	-0.333*	0.118 [0.081]	0.000 [0.000]	-0.118	0.058 [0.023]	0.000 [0.000]	-0.058
N	27	8		17	3		104	20	
Proportion of full adopters		23%			15%			16%	

(continued)

Table 6.5 (continued)

Variable	-----LF-----			-----POF-----			-----OF-----		
	(1)	(2)	<i>t</i> -test	(1)	(2)	<i>t</i> -test	(1)	(2)	<i>t</i> -test
	Non or incomplete adopters	Full adopters	Difference	Non or incomplete adopters	Full adopters	Difference	Non or incomplete adopters	Full adopters	Difference
	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)	Mean/SE	Mean/SE	(2)-(1)
<i>F</i> -test of joint significance (F-stat)			3.227***			65.413***			4.906***
<i>F</i> -test, number of observations			35			20			124

The values displayed for *t*-tests are the differences in the means across the groups
The values displayed for *F*-tests are the *F*-statistics
***, **, and * indicate significance at the 1, 5, and 10% critical levels

Fifth, the project provided five training sessions at the demo plots, and among them, four trainings were relevant to the adoption of the five key practices. Hence, the dummy variable for the participation of all four trainings is created. The table shows that the full adopters were more likely to be the farmers who joined all four trainings, except for the case of POF, where the sample size and therefore the number of full adopters was very small. This indicates the importance of completing the demo farm training for fully adopt the five key practices.

Now we turn to the analysis of social learning or F2FE. The sixth feature is that the full adopters are more likely to have acquaintances who would also lean toward being full adopters (see the variable “Knows at least one full adopter among baseline members”). This feature seems to imply that there are two mechanisms of farmer-to-farmer knowledge dissemination. The first is that similar persons are likely to know each other (a correlated social effect or positive sorting/assortative matching). Second, acquaintances learn new practices from each other (a social learning effect). Statistically disentangling these two effects is difficult unless the researcher can identify the independent variables.

Seventh, in order to obtain insights into the abovementioned identification issue, we created a variable defined as the proportion of known LF, POF, or OF among the members from whom the respondent learned any of the five key practices. For example, in the case of LF, the denominator is the total number of sample members, and the numerator is the number of LF from whom the respondent learned any practices. We compare this proportion between the full adopters and the non- or partial adopters. The table indicates that, in LF’s case, learning from the other LF, POF, or OF members was much less for the full adopters and it was statistically significant. Besides, in the POF’s and OF’s cases, learning was also lower among the full adopters (except in the case of learning by POF from the other LF members), although these figures are not statistically significant. All in all, the results do not demonstrate that social learning or F2FE was a strong channel of diffusion, at least in the duration between the baseline and follow-up survey periods.

Meanwhile, as indicated by the dummy of full training participation, our survey indicated the effectiveness of FFS for full adoption. To investigate this aspect, we constructed Table 6.6, which lists the most important information sources for new practices among adopters in the follow-up season. The sources are classified into six categories: through demonstration plot participation, from extension workers, from other farmers, through observation of the plots of unrecognized farmers, and cases where the practice was already known prior to the training. The results indicate that the demonstration plots or the extension workers were the two key sources where the farmers were exposed to the new practices for the first time, indicating that these two key components of FFS can effectively make farmers aware of these new practices. If this is the case, however, the cost of disseminating new rice production management practices to a large number of rainfed farmers in this country will be high.

Table 6.6 Practice adoption and source of the most important information in the follow-up survey

Practices	Source of information among adopters (%)				
	Demonstration plot participation	Extension workers	From other farmers	Observation	Ever known
(S) Seed test by water	39.39	55.56	4.05	0	0
(N) Nursery bed set up	39.40	55.60	5.05	0	0
(B) Bund construction	44.12	25.49	7.84	4.90	17.65
(L) Leveling	37.62	56.44	0	3.96	1.98
(TP) Straight-row transplanting	33.33	63.89	2.78	0	0
Rice variety (Mamima)	12.82	12.82	0	10.26	64.1
Rice variety (Mocuba)	9.52	68.25	7.94	7.94	6.35
Rice variety (Chupa)	29.82	38.60	3.51	15.79	12.28

Sample size = 257

Source Authors

6.6 Conclusion

This chapter evaluated the RCT of rice farm management training in the rainfed lowlands of Mozambique. Our analyses found a positive impact from the training on the adoption of recommended practices and rice yield. The ITT effect on paddy yield was 447–546 kg/ha (or an increase of between 29 and 36% of the control group average yield). This impact was achieved through the adoption of basic practices alone without modern inputs, indicating that even poor farmers in remote areas can benefit from management practice training.

Our analysis suggests that the full adoption of all five key practices was important for increasing the yield, and FFS was effective in achieving this purpose. Meanwhile, our data did not clearly indicate the dissemination of practices through F2FE or social learning, at least in our survey period. Among many possibilities, one possible reason for the ineffectiveness of F2FE in our survey area can be attributed to the diverse agro-ecological conditions of the rainfed areas. Since plot characteristics are highly heterogeneous among the farmers in rainfed areas, appropriate practices may differ among the plots. Hence, the practices that farmers acquire through social learning may not be appropriate for their own plots, and thus, simply mimicking what they see

may not be effective. In the long run, however, as the significant impact of practices becomes well understood (and thus the adopted farmers themselves become good instructors), social learning mechanisms may emerge. Further research on external validity as well as long-run impact assessment would provide a better understanding of the appropriate training design in rainfed field-dominant areas in SSA in general and Mozambique in particular.

Appendix

See Tables 6.7 and 6.8

Table 6.7 Estimation results for the non-attrition probit model

	Non-attrition = 1
Household size	−0.00415 [0.9165]
Head's education (years)	−0.0335* [0.0800]
Head's education squared	0.000253* [0.0705]
Log of assets	0.0866* [0.0600]
Total plot area (ha)	−0.594 [0.6500]
Total plot area squared	0.521 [0.4050]
Proportion of known members (%)	−0.0107* [0.0630]
Weather shock in the last rice season (= 1)	−0.341 [0.1200]
Weather shock in the last non-rice season (= 1)	−0.248 [0.3970]
Constant	1.382** [0.0235]
Observations	311

Wild bootstrap cluster robust p -values in brackets

** $p < 0.05$, * $p < 0.1$

Source Authors

Table 6.8 Full estimation results of ANCOVA model on the impact of training: rice productivity and technology adoption

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Paddy yield	Seed test by water	Nursery bed set up	Bund	Leveling	Straight-row TP	Use all 5	Use manima	Use Mocuba	Use Chupa
Y0	0.139** [0.0250]	-0.0585 [0.1760]	0.214** [0.0230]	0.0530 [0.6040]	0.0596 [0.2805]	-0.207 [0.8035]	N/A	-0.0325 [0.6185]	0.141 [0.1710]	0.0469 [0.4885]
Demo 1 (treatment)	545.5* [0.0795]	0.570*** [0.0085]	0.592*** [0.0005]	0.376** [0.0440]	0.609*** [0.0390]	0.508* [0.0750]	0.367* [0.0635]	0.0903* [0.0985]	0.0895 [0.3710]	0.0899 [0.6010]
Demo 2 (treatment)	447.5* [0.0650]	0.479* [0.0710]	0.461*** [0.0000]	0.326** [0.0265]	0.416** [0.0400]	0.449** [0.0100]	0.200 [0.2015]	-0.00583 [0.8485]	-0.0568 [0.7730]	0.289 [0.1380]
Household size	-50.13 [0.7935]	0.00336 [0.9415]	0.0117 [0.7195]	-0.0886** [0.0440]	-0.0470 [0.4720]	-0.0124 [0.6835]	-0.0101 [0.6135]	-0.0516 [0.1060]	0.0243 [0.6995]	0.0241 [0.5025]
Household size squared	6.379 [0.7400]	-1.21e-05 [0.9980]	-0.00158 [0.6385]	0.00943** [0.0310]	0.00386 [0.5495]	0.000529 [0.8305]	0.00189 [0.3550]	0.00537 [0.1430]	-0.00286 [0.5665]	-0.00510 [0.1475]
Head's education (years)	-9.454 [0.5520]	-0.00581 [0.4375]	-0.0110 [0.2720]	-0.00308 [0.6505]	6.11e-05 [0.9975]	-0.0131 [0.2320]	0.00323 [0.6085]	-0.00110 [0.7480]	-0.00589 [0.1570]	0.00546 [0.5470]
Log of assets	52.09 [0.1280]	0.0221 [0.1715]	0.000723 [0.9640]	0.0210 [0.1750]	0.000923 [0.9670]	0.0118** [0.0115]	0.00708 [0.1505]	-0.00833 [0.1940]	0.0223 [0.1080]	-0.0249* [0.0655]

(continued)

Table 6.8 (continued)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Paddy yield		Seed test by water	Nursery bed set up	Bund	Leveling	Straight-row TP	Use all 5	Use mamima	Use Mocuba	Use Chupa
Total plot area (ha)	-1.563*** [0.0005]	-0.0910 [0.4460]	-0.0191 [0.8800]	0.0476 [0.5050]	-0.201* [0.0755]	-0.0425 [0.6575]	-0.141 [0.1020]	0.156* [0.0620]	0.0575 [0.4120]	0.0456 [0.3550]
Total plot area squared	240.6*** [0.0000]	0.0367 [0.1000]	0.0141 [0.6005]	-0.00230 [0.8695]	0.0574** [0.0270]	0.0246 [0.1820]	0.0353* [0.0675]	-0.0295 [0.1410]	-0.0123 [0.3420]	-0.00121 [0.9190]
Proportion of known members (%)	3.53 [0.1385]	-0.00178 [0.4065]	-0.000388 [0.8235]	0.00213 [0.1070]	0.000296 [0.9145]	0.000119 [0.9570]	0.000352 [0.9355]	-0.000444 [0.7640]	0.000147 [0.9340]	-0.00120 [0.3040]
Weather shock rice	130.8 [0.6210]	0.0317 [0.6850]	-0.0932 [0.2270]	0.0340 [0.2275]	-0.152 [0.3960]	0.0719 [0.3735]	0.0852 [0.3490]	-0.0312 [0.6725]	-0.0490 [0.2080]	-0.104 [0.3905]
Weather shock non-rice	-140.4 [0.7535]	-0.136 [0.1005]	-0.0140 [0.8585]	0.0651 [0.1620]	0.125 [0.1460]	-0.0616 [0.3565]	-0.0155 [0.5815]	0.0665* [0.0860]	-0.0308 [0.5400]	0.0596 [0.3820]
Constant	1.735*** [0.0010]	0.222 [0.1255]	0.266* [0.0960]	0.173 [0.4895]	0.0178 [0.9205]	0.0317 [0.8035]	0.0190 [0.8065]	0.0961 [0.4015]	0.226 [0.4950]	0.316*** [0.0080]
Local unit FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
t-test (Demo 1 = Demo 2)	0.8372 [0.5005]	0.7911 [0.5795]	1.3768 [0.3330]	0.5446 [0.7695]	1.3559 [0.4005]	0.4146 [0.7605]	1.7405 [0.1900]	2.0472* [0.0570]	1.8529 [0.1910]	-1.7335 [0.2235]
Control mean value	1535	0.141	0.333	0.192	0.038	0.00	NA	0.167	0.231	0.064
Observations	257	257	257	257	257	257	257	257	257	257
R-squared	0.363	0.300	0.413	0.510	0.395	0.380	0.418	0.403	0.525	0.302

Wild bootstrap cluster robust *p*-values in brackets; Inverse probability weights are used to control for attrition bias (see Table 6.7 for the probit analysis of non-attrition)
N/A: No variation in the baseline observations. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
Source Authors

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